Losing Calcium In Space

Activity Objectives

- To find out which bones in the human body support most of a person's weight
- To realize that those bones lose calcium during space flight
- To understand that on Earth, our bones are under constant pressure from the weight of our bodies
- Calcium makes our bones strong
- Bones tend to lose calcium when they stop doing work

Materials

- ✓ Diagram or model of a human skeleton
- ✓ A human skeleton diagram for each student
- ✓ Cup of vinegar and a chicken bone

Background

Calcium is essential to maintaining strong bones. Its loss weakens bones and causes them to break more easily. Calcium loss can also increase the threat of kidney stones as the mineral is excreted. Some humans have a tendency to lose calcium in their bones as they age. To prevent or slow this loss, we can do exercises or activities – such as running, jumping, cycling, swimming, and rowing – that put pressure on the bones in our lower back and legs.

Running and jumping are not as effective in space as they are on Earth because a person's weightless limbs can provide little resistance. However, astronauts can use a modified treadmill. Elastic cords attached to the waist and treadmill hold an astronaut down in order to produce a force on the limbs. The cords also prevent astronauts from flying off in the opposite direction when they stamp a foot. Even with the straps, the astronaut is using less force than on Earth. Astronauts can also be strapped onto cycling and rowing machines.

<u>Calcium's Link to Space</u>

Astronauts lose calcium during space flight, with more loss on longer missions than on shorter ones. Just as weight-bearing muscles lose the most strength and mass, weight-bearing bones seem to lose the most calcium. The changes in bones and muscles seem tied to loading, or the amount of force to which each is subjected. The calcium loss is very site specific, differing not only from bone to bone, but at various sites of the same bone. Researchers are still trying to determine the most efficient exercises for counteracting the effects of weightlessness. Currently, astronauts perform isometric exercises in which they push against resistant surfaces such as the modified treadmill.

Calcium is an extremely important mineral for our nerves and blood as well as for our muscles and bones. Its loss during space flight is a major concern for astronauts for many reasons, including the fact that no one knows yet if acute calcium loss is completely reversible. Astronauts minimize the loss as much as possible by eating calcium-rich foods, exercising appropriately, and taking certain medications.

Certain bones support most of our weight when we are on Earth. These bones no longer support any weight when humans are in space; thus, their calcium content decreases over time and they weaken. This loss of calcium and weakening does not impair astronauts' performance in space, but it poses a concern once they return to Earth. In this activity, students study diagrams and models of human skeletons to determine which bones support most of a person's weight.

Instructions

Part A

Examine the diagram of the human skeleton, and answer the following questions.

1. Find and label the following bones: vertebrae, pelvis, femur, fibula, tibia, and calcaneus (heel).

2. Compare the bones in the hand with those in the foot. How are they similar? How are they different?

3. Which bones support most of a standing person's weight?

4. Which bones support very little weight when a person is standing?

5. Connect the bones that support weight, going up from the foot to the neck.

6. Compare the function of the bones in the hand with that of the bones in the foot. How does the structure of each suit their different functions?

7. Compare the front and back legs of a four-footed animal with the arms and legs of a human.

8. How would losing calcium during space flight affect astronauts?

9. What exercises on Earth put pressure on the bones in your lower back and legs?

10. What exercises would help astronauts put pressure on their legs and spines? (Remember, they are in a weightless environment where certain kinds of exercises might not help.)

Part B

1. Partially submerge a dry, cooked chicken bone in a glass of vinegar and leave it for about one week.

2. Examine the bone carefully during the week. What do you notice?

The weak acid (vinegar) dissolves the calcium phosphate and other mineral in the bone. Decalcification of human bones is much less dramatic, but the results are similar; the bones weaken and break more easily. If you do this with a wishbone, you should be able to tie a knot in it at the end of the experiment.

Glossary

Calcium - A mineral that is an important component of bone; also found in teeth, dairy products, and chalk, among other things.

Weightlessness - A condition in which no object will register any weight on a scale.